THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

FINAL REPORT

ACTIVE REGIONS

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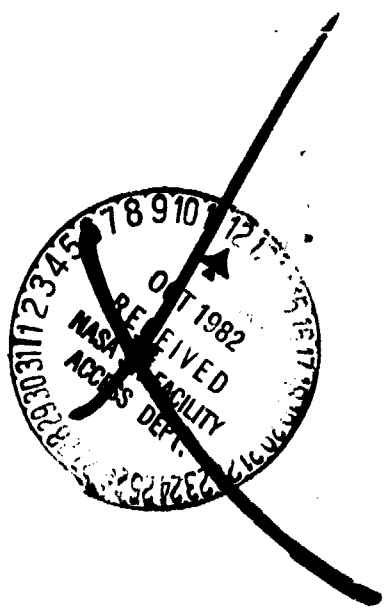

The following efforts have been completed in support of the Solar Maximum Mission (SMM) under contract NAS8-33525:

(1) The evolution of solar vector photospheric magnetic fields in a flare-producing active region has been studied and reported in the literature (e.g., Krall et al., 1982, see Appendix I). Rapid horizontal motions have been found to accompany transverse magnetic field alignment with the magnetic neutral line (a state of high shear capable of energy storage), and have preceded the times of highest frequency of flaring. Electric current magnitudes were estimated and appeared to flow along the stressed fields. The rate of magnetic energy storage during the period of the specific active region studied was estimated and surpassed the total energy released during all the flares of the period.

SMM Ultra-Violet Spectrometer Polarimeter (UVSP) spectral imagery has been compared to the current distributions to investigate the role of current dissipation in the energy release process.

(2) An algorithm has been developed to generate maps of force-free magnetic field strengths at varying heights in the solar atmosphere. This code has been used specifically in the following:

a) To assess the relative contribution of free-free and gyroresonance absorption processes to measured radio emissions for an SMM observed active region (Schmahl et al., 1982, see Appendix II). The methods have been documented and results indicate that Very Large Array (VLA) active region radio maps can be explained by second through fourth harmonic gyroresonance absorption confined in areas associated with relatively large magnetic fields. SMM x-ray spectroheliograms were used to identify coronal material

confined by the field configuration, and corresponded more closely with the extrapolated fields than with radio emissions.

b) To investigate magnetic field gradients above the solar photosphere. In the mode extrapolated fields are compared with SMM/UVSP polarization measurements to check the consistency of each.

(3) A study of the physical state of the material confined along entire magnetic loops has been advanced with the use of magnetic field extrapolation. Hydrogen Lyman-α and continuum images obtained from rocket flights have for the first time enabled a direct connection to be established between photospheric magnetic footpoints and SMM high temperature x-ray structures (Acton et al., in preparation). Force-free field calculations have been modified to provide field lines with sufficient fidelity to model individual loops, so as to provide a basis for identifying magnetically connected material at photospheric (T = 5000° K), chromospheric (10^{5}° K) and coronal (10^{6}° K) temperatures.

Published Journal Papers

Krall, K. R., Smith, J. B., Hagyard, M. J., West, E. Al, and Cummings, N. P., 1982, Vector Magnetic Field Evolution, Energy Storage, and Associated Photospheric Velocity Shear Within a Flare-Productive Active Region, Solar Phys., 79, 59 (Included as Appendix I).

Schmahl, E. J., Kundu, M. R., Strong, K. T., Bentley, R. D., Smith, J. B., and Krall, K. R., 1982, Active Region Magnetic Fields Inferred From Simultaneous VLA Microwave Maps, X-Ray Spectroheliograms, and Magnetograms, Solar Phys., in press (Included as Appendix II).

Published Abstracts of Presented Papers

Krall, K. R. and Hagyard, M. J., 1981, Magnetic Energy Within a Flare-Productive Delta Configuration, B.A.A.S., 12, 899.

Smith, J. B., Krall, K. R., Hagyard, M. J., Cummings, N., West, E., 1981, The Magnetic Evolution of AR2372, B.A.A.S., 12, 899.

Krall, K. R., Wu, S. T., Hagyard, M. J., West, E. A., Cummings, N. P., and Smith, J. B., 1980, Analysis of Changes in Photospheric Magnetic Fields Within a Flare-Productive Active Region, B.A.A.S., 12, 514.

Wu, S. T., Hu, Y. Q., Krall, K., Hagyard, M. J., and Smith J. B., 1981, Modeling of Energy Buildup for a Flare-Productive Region, B.A.A.S., 13, 821.

Smith, J. B., Strong, K. T., Schmahl, E. J., Kundu, M. R., Krall, K. R., and Bentley, R. D., 1982, Active Region Magnetic Fields, B.A.A.S., 13, 881.

Smith, J. B., Cummings, N. P., Hagyard, M. J., Smith J. E., Krall, K. R., 1980, Vector Magnetic Field Measurements at Flare Locations, B.A.A.S., 12, 514.